III. "Contributions to the Anatomy of the Central Nervous System of Plagiostomata." By ALFRED SANDERS, M.R.C.S., F.L.S. Communicated by Dr. GÜNTHER, F.R.S. Received December 11, 1885.

(Abstract.)

After referring to the literature of the subject, the author gives a short account of the macroscopic appearance of the brains of the following species of Plagiostomata, viz., *Raja batis*, *Rhina squatina*, *Scyllium catulus*, and *Acanthias vulgaris*. He then refers to the distribution of the cranial nerves, especially of the trifacial and vagus, pointing out the resemblance of the distribution of the last-mentioned nerve in Rhina to that described by Gegenbaur* in Hexanthus; the difference lying in the fact that in the former the rami branchiales of this nerve, the number of which correspond to the number of the branchial arches, divide into two terminal branches only, the rami anteriores and posteriores, the third, the rami pharyngei, being absent.

On the other hand, in Scyllium the rami branchiales do not divide, the terminal twigs, representing the rami pharyngei, only being present.

The lobi olfactorii consist of two parts, the lobe proper and the peduncle. The lobe itself is more or less pear-shaped, broader at the anterior end where it abuts on to the olfactory organ, and narrower behind where it passes into the peduncle. It consists of three layers, counting from before backward, or from outside inward. The posterior, which is also the internal layer, occupies more than half of the lobe, and consists entirely of a mass of small cells embedded in a network of fibrillæ and granular neuroglia. This network is of extreme tenuity, and the cells contained therein are oval, pear-shaped, or spherical in shape, and contain a nucleus and nucleolus; they give off processes which join the network. In front of these, and outside to a certain extent, is found a layer consisting of glomeruli olfactorii; these are elongated or pear-shaped masses arranged with their long axes in the direction of the nerve fibres. They consist of a central core of closely intertwined fibrillæ; externally the fibrils are of rather larger size; they run longitudinally in reference to the glomerulus; in their course elongated cells are developed.

The anterior or external layer consists of interlacing bundles of fibres which pass from the anterior ends of the glomeruli into the olfactory organ. The bundles themselves are flat, but the fibrillæ of which they are composed are round.

* "Jenaische Zeitschrift," Bd. 6, 1871.

The structure of the peduncle resembles that of the olfactory lobe, and gradually passes into that of the cerebrum at the posterior end. In Scyllium, Rhina, and Acanthias it contains a passage which puts the ventricle of the olfactory lobe into communication with that of the cerebrum. In Raja, however, both the lobe and the peduncle are solid.

The cerebrum contains two ventricles which posteriorly communicate with a single chamber, the foramen of Monro; this is the case in Scyllium, Rhina, and Acanthias, but in Raja only a very small ventricle is present which represents the foramen of Monro, the remainder of the cerebrum being solid. Round the external surface of the cerebrum there is a layer of granular neuroglia with comparatively few cells. The remainder of the parenchyma consists of a mass of cells, larger ones, 13μ to 10μ in diameter, occupying the centre, and smaller ones predominating towards the internal surface. In Scyllium the cells are arranged in groups of four or five, and in Raja also in groups of from nine to twenty-one, which make a meandering pattern through the parenchyma in some parts. At the base of the cerebrum there are four special groups of cells, two being placed in the outer walls and two in the inner walls; the outer groups are associated with the fibres of the anterior commissure, and the inner groups are associated with the fibres of the crura cerebri.

The third ventricle is a gutter-shaped channel, long in Scyllium, but shorter in Raja, which leads from the cerebrum into the optic lobe; above, it is closed in by processes of the pia mater which enter the ventricle and the foramen of Monro, forming a choroid plexus; below, the third ventricle communicates by a passage, the infundibulum, with the ventricles of the hypoarium; the parenchyma in this lobe contains numerous cells measuring from about 13μ by 7μ to 6μ in diameter, which give off numerous processes to join a fine network which pervades the whole. The ventricle is lined by an endothelium which is continuous with a space in the hypophysis cerebri. There is a small tubercle in front of the optic lobe which corresponds to the tuberculum intermedium of Gottsche,* and from it a bundle of fibres can be traced passing towards the ventral surface of the medulla oblongata, which corresponds to the fibres of Meynert.

The optic lobes which homologise with the anterior corpora quadrigemina form a cover arching over the aqueduct of Sylvius, in the same position as in the Teleostei; they are much thicker, but more simple in structure. Neither the tori longitudinales nor the tori semicirculares, those tuberosities which form prominences on the floor of the aqueduct in the Teleostei, are present in the Plagiostomata. Three layers may be distinguished in the optic lobe; the external

* "Müller's Archiv," 1835.

occupies about two-thirds of the thickness, and consists of longitudinal fibres which are derived from the optic tract, and numerous cells which attain their maximum number in this layer; they are mostly spherical, but fusiform cells with their long axes placed radially are occasionally found.

The second layer consists of bundles of transverse fibres partly derived from the lateral columns of the medulla oblongata, and partly from the commissura ansulata; they correspond with the transverse fibres in the tectum lobi optici of the Teleostei.

The third layer is characterised by large cells, which are rounded or sometimes pyriform; they usually give off only one process which is directed outwards, and joins the above-mentioned transverse fibres. These cells differ in their arrangement in the different species, they are spread out in a flat layer in the optic lobe of the Scyllium and Raja. In Rhina and Acanthias they form a group in the central tuberosity that projects into the aqueduct of Sylvius, resembling the arrangement in the Turtle. The small cells which were described in the first layer extend in diminishing numbers into this third layer.

The cerebellum in Scyllium, Rhina, and Acanthias presents a very large ventricle which in Raja is nearly obliterated; the intimate structure resembles that of the Teleostei. There are the four layers, the molecular with Purkinje cells, the granular and the fibrous layers. The latter is connected by the crura cerebelli ad medullam through an inferior lobe with the restiform bodies of the medulla oblongata; there is also an anterior cord passing longitudinally into the optic lobe which represents the crura cerebelli ad cerebrum (Quain). In the granular layer, in addition to the numerous cells forming that layer, there are little masses of fibrillæ inextricably wound together resembling glomeruli on a small scale; in other respects there is nothing peculiar in the structure of the cerebellum.

The molecular and the granular layers are continued on the surface of the restiform bodies in all the species examined, and in Raja nearly as far as the posterior end of the fourth ventricle, but the absence of the Purkinje cells marks a difference of structure.

In the spinal cord the grey substance of the ventral cornu contains numerous large cells arranged in an imbricated manner with their long axes directed obliquely from the ventral to the dorsal surface. Their shape is generally elongated, and they give off several processes. In the cord the ventral cornua are directed horizontally, but towards the posterior end of the medulla oblongata they are gradually depressed toward the ventral surface, and are finally lost in the grey substance on the floor of the fourth ventricle. The dorsal cornua contain numerous nuclei. There are four longitudinal columns in the spinal cord, the ventral longitudinal columns beneath the central canal, the lateral columns at the sides, and the dorsal columns above. Mauthner's

fibres are not present in the Plagiostomata, the fibres of the ventral longitudinal columns varying very slightly in size; but perhaps, it may be mentioned here that large fibres, two in number, occupying positions corresponding to those of the Mauthner's fibres in Teleostei, occur in Ceratodus; they have the peculiarity of possessing several axis cylinders inclosed in a single medullary sheath.

The ventral columns form projecting longitudinal cords in the floor of the fourth ventricle. They can be traced into the ventral side of the posterior commissure which occupies the usual place at the posterior boundary of the third ventricle.

The lateral columns on passing forward diminish greatly in number, the internal fibres are lost in the neighbourhood of the posterior commissure; those that are external seem to join the transverse fibres of the optic lobe, those between the two disappear in the region above the hypoarium, some crossing the crura cerebri which disappear in the same region.

The optic nerves form a chiasma, the lower part of which is formed by the nerves of the two sides intersecting each other in bundles, but in the upper part the remainder cross each other *en masse*. The principal origin of this nerve is the optic lobe, where the outer two-thirds are occupied by its tract; a few fibres, however, are derived from the hypoarium.

The oculo motorii are derived from two ganglia situated on the floor of the aqueduct of Sylvius; they pass nearly straight down to the ventral surface of the medulla oblongata. At this region there is a system of transverse commissures connected with the second layer of the optic lobe, which corresponds to the commissura ansulata of Teleostei (Gottsche).*

The ganglion of origin of the trochlearis was not found, but the fibres decussate at a part between the optic lobe and the cerebellum corresponding to the valve of Vieussens.

The trifacial is derived from three roots, one of which comes forward from the posterior part of the medulla oblongata, where it can be traced into the lateral columns. The other comes backward through the tuberosity of the trifacial by the side of the medulla; these two cross each other at their entrance into the nerve, the third comes from a group of cells in the grey substance of the floor of the fourth ventricle.

The abducens can be traced from the ventral surface of the medulla oblongata at about its centre into the lower edge of the ventral longitudinal columns.

The facial can be traced into a small bundle of fibres which passes backward into the spinal cord in the substantia gelatinosa centralis just above the central canal.

* *Loc. cit.*, p. 439.

About this region there is a system of arched commissural fibres, the fibræ arcuatæ. They seem to be connected with the crura cerebelli and medullam. They occur not only through the external part of the ventral surface, but also through the central portions.

The acusticus and glossopharyngeal arise from the grey substance on the floor of the fourth ventricle.

The vagus arises from a series of rounded tuberosities situated on the side of the floor of the fourth ventricle; each root arises from a separate tuberosity.

The spinal nerves arise by dorsal and ventral roots; the latter from the ventral horn of grey substance. The former pass obliquely into the interior of the cord and there divide into two bundles; one bundle from the anterior part of the root is directed backward, the other bundle from the posterior part of the root is directed forward. They pass over the next nerve both in front and behind, and join the lateral columns of the cord. This arrangement was first described by Stieda.*

January 14, 1886.

Professor STOKES, D.C.L., President, in the Chair.

The Presents received were laid on the table, and thanks ordered for them.

The following Papers were read:—

I. "On the Action of Sunlight on Micro-organisms, &c., with a Demonstration of the Influence of Diffused Light." By ARTHUR DOWNES, M.D. Communicated by Professor MARSHALL, F.R.S. Received December 9, 1885.

Eight years ago, conjointly with my friend Mr. Blunt, I communicated to the Royal Society an account of an experimental inquiry into the action of sunlight on the micro-organisms of putrefaction and decay.†

We adduced evidence, conclusive in our opinion, that the solar rays were very hostile to these lowly forms of life; so much so that under favourable conditions bright sunlight, sufficiently prolonged, would altogether prevent their appearance in fluids which, under

* "Zeitsch. f. Wiss. Zoologie," Bd. 23, 1873.

† "Proc. Roy. Soc.," vol. 26, p. 488, and vol. 28, p. 199.